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K1 (Invited)

FIBER BASED ACOUSTO-OPTIC TUNABLE FILTER

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SUMMARY

Silica glass optical fiber is widely used to transport optical signals in optical communications and sensor systems. While the optical fiber provides extremely low loss propagation, it is not straightforward to actively control light without taking light outside of fiber. The process of taking light out of the fiber and put it back in after actively modifying it introduces undesired loss and complexity. Efforts have been made with success to develop all-fiber active components including phase modulators by stretching optical fibers, doped fiber amplifiers, and wavelength tunable filters by thermally tuning fiber Bragg gratings. Devices based on non-linear optical process are also actively studied. Acousto-optic effect has long been used as an efficient means to modulate light propagating in dielectric material, and its application to optical fiber opens up many possibilities.

In this talk, the basic principle and applications of fiber-based acousto-optic devices will be discussed. In particular, acousto-optic interaction due to flexural acoustic waves traveling along the length of optical fiber will be described in detail. Flexural acoustic wave produces periodic microbends in the glass fiber and causes highly efficient coupling between modes. Several examples of all-fiber devices will be explained including frequency shifter, tunable wavelength filter (Fig. 1) [1], dynamic gain equalizer [2], dynamic optical add-drop multiplexer, optical switch (Fig. 2) [3], wavelength tunable fiber lasers [4], and variable optical attenuator (Fig. 3) [5]. The highly efficient and low loss devices are beginning to find applications in optical fiber sensors and communications.

References

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2. H. S. Kim, S. H. Yun, H. K. Kim, N. Park, and B. Y. Kim, "Actively gain-flattened erbium-doped fiber amplifier over 35 nm by using all-fiber acoustooptic tunable filters," IEEE Photon. Techlol. Lett., vol. 10, pp.790–792, 1998.

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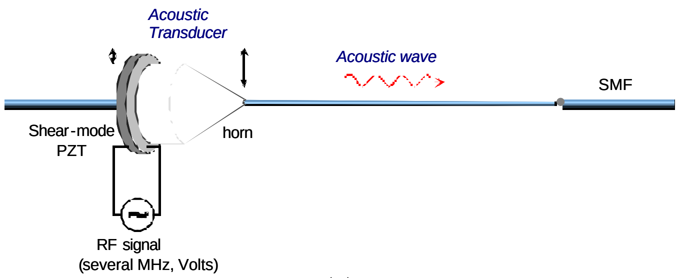

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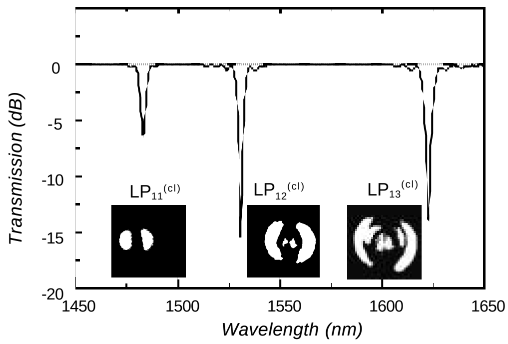


(b)

Fig. 1. All-fiber acousto-optic tunable filter. (AOTF) (a) Schematic of the AOTF. PZT, piezoelectric transducer; SMF, single-mode fiber. (b) Transmission spectrum for a broadband source, showing coupling to three different cladding modes [LP11, LP12, and LP13] at an acoustic frequency of 2.33 MHz. Insets, farfield radiation patterns of the cladding modes

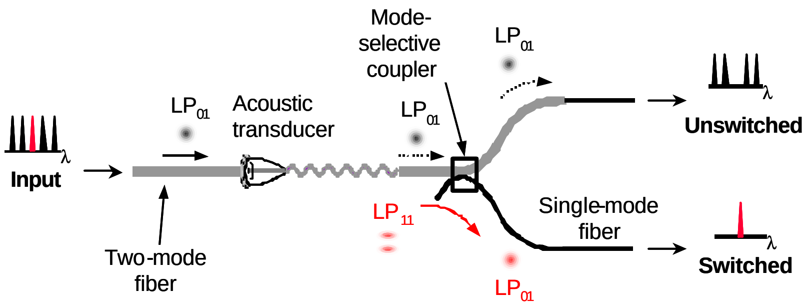
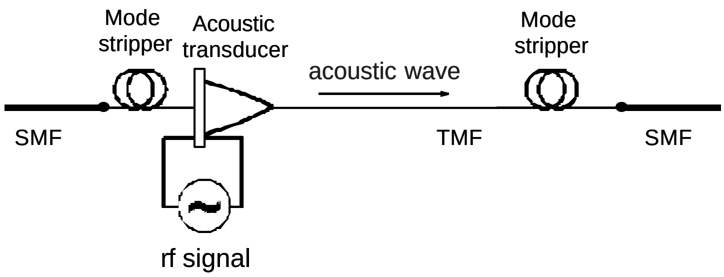


Fig. 2. All-fiber wavelength-tunable acousto-optic switch.



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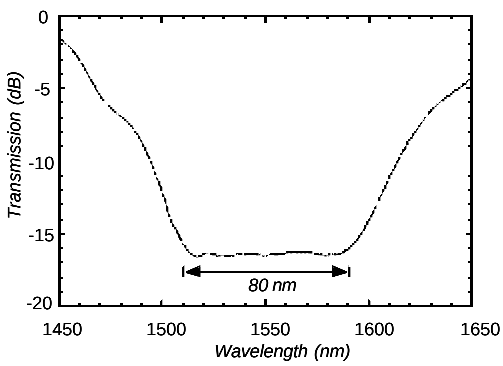

(b)

Fig. 3. (a) Schematic of acousto-optic variable optical attenuator. (VOA) TMF, two-mode fiber; SMF, single-mode fiber. (b) Transmission spectrum of the VOA.